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No. 53-51

April 5, 1974

Attaché of the U.S. Embassy in the U.S.S.R.

Mr. J.L. Tech

State Dept. declassification & release instructions on file

Dear Mr. Tech,

I hereby inform you that the Soviet side has agreed to send a delegation of Soviet specialists on the use of plastics in hydraulic engineering to the U.S. in July 1974.

The coordinator for the topic "Planning and Elaboration of Measures for the Rational Use of Water Resources," A.M. Volynov, is prepared to receive an American delegation to the U.S.S.R. for a period of two weeks beginning ~~May 4~~ ^{May 11}. This date is proposed in view of the fact that after May 20

Mr. Volynov will be occupied with another project, planned earlier. The program for the visit of the American experts includes a tour of the country (preliminary itinerary - Moscow-Krasnodar-Simferopol-Kherson-Moscow) and agreement on a specific program of work on the topic of cooperation.

The coordinator for the topic "Methods and Means of Automation and Remote Control of Reclamation Systems," O.A. Bilik, confirms the proposal sent earlier for the meeting of experts in the U.S. and suggests that the visit of Soviet experts begin in June 1974. A corresponding visit of the American delegation is proposed for the end of August or the beginning of September. The Soviet coordinator is awaiting an answer from the American side.

Water Resources

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An answer will be sent to the American side shortly on the topic "Technology of Construction in Cold Climates," together with a proposal for the program of cooperation. You will be informed of the status of this topic supplementarily.

I.I. Borodavchenko
Chairman of the Soviet Side
of the Joint Soviet American Working
Group on Water Resources

Copies to:

1. GKNT [SCST]
2. Counselor of the U.S.S.R. Embassy in the U.S.A. Kh.T. Peterson

DEPARTMENT OF STATE
DIVISION OF LANGUAGE SERVICES

(TRANSLATION)

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MINISTRY OF RECLAMATION AND WATER ECONOMY OF THE U.S.S.R.

No. 53-51

February 26, 1974

Mr. William H. Keating
Deputy Special Commissioner
Bureau of Reclamation
U.S. Department of Interior

Dear Mr. Keating:

Attached hereto please find a brief review of the status in the U.S.S.R. of the problem of using plastics in hydraulic engineering.

The material also includes proposals of Soviet specialists concerning the questions on which exchange of information appears to be advisable in the future.

I should be grateful if in your reply you would let us know the questions on which the American specialists would like to receive information.

Respectfully,

[s] P. Sviklis
Director, LatNIIGiM Institute
Subject Coordinator

Enclosure: As mentioned, in duplicate

Copies of letter (without enclosure) to

1. State Committee for Science and Technology
2. Dr. J.L. Tech, Science Attaché, U.S. Embassy

MINISTRY OF RECLAMATION AND WATER ECONOMY OF THE U.S.S.R.

Latvian Research Institute of Hydraulic Engineering and
Reclamation (LatNIIGiM)

I N F O R M A T I O N

on subject II-3 "Plastics in Hydraulic Engineering"

of the project of scientific and technical cooperation
with the United States of America on water resources.

- 1973 -

One of the primary applications of polymers are film screens and membranes to control filtration and to stabilize soils in canals, reservoirs and storage basins.

It is advisable to carry out U.S.-U.S.S.R. cooperation on the subject "Plastics in hydraulic engineering" by organizing the following joint investigations:

1. Design and construction techniques of film screens in irrigation canals.
2. Use of films in the construction of reservoirs controlling local runoff, development of inexpensive and long-lasting films with wide panels, and improvement of the design and construction techniques for screens, supports and other structures.
3. Deterioration processes of polymer films under various conditions of weather, soil, and aggressive media.
4. Development of compounds and utilization techniques of polymers for the artificial stabilization of soils on slopes of canals and reservoir dams, the sealing of joints, and the improvement of the properties of concrete.

The present paper reports on the experience gathered by the U.S.S.R. in the field of investigating and developing construction techniques for screens using polymer films to control filtration. The paper has been prepared by the Latvian Research Institute of Hydraulic Engineering and Reclamation (the lead institute for subject II-3) from materials of research institutes and design organizations.

1. Design and construction techniques of film and concrete-film revetment in irrigation canals.

The U.S.S.R. has accumulated considerable experience in using film screens and concrete-film revetment as anti-filtration devices in irrigation canals in

the southern parts of the country (Central Asia, the Ukraine, the Trans-Volga region).

We have used films of polyethylene (PE) and polyvinylchloride (PVC) stabilized with carbon black and age resistors, not less than 0.2 mm thick, with panels up to 8.0 m wide and 110-150 m long.

The film screens in irrigation canals are built according to the trench, perimetric or combined systems with or without a protective layer (of soil or concrete).

The selection of the construction system depends on the type of soil, the size of the canal, the mechanical equipment available, the height of the fill, and other conditions.

The experience in applying polymer screens in irrigation canals has been gathered mostly from the construction of structures with a flow rate of up to 2.5 m³/sec. At the present time, however, film screens have been built and successfully used also on large-size water-delivery and irrigation canals with flow rate ranging between 40 m³/sec and 500 m³/sec (Kakhovskiy and Kuybyshev canals).

Investigations and industrial practice have shown that the use of film screens in main canals with protective soil covering is quite effective. Analysis of technical and economic data from the Kakhovskiy canal (flow rate 530 m³/sec) with different variants of anti-filtration lining has shown that the expenses of installing 1 m² of a 1-m thick soil-film screen with a 14-16 cm thick concrete casing in the wave action zone are 2.5-3.0 times less than with other methods, for instance, a 20-cm thick concrete lining on soil foundation.

Investigations and operational experience also show that in the case of large-size continuously operating main canals it is more expedient to use combined casings consisting of a soil-film screen (below water level) and a concrete-film lining in the wave action zone. This solution is being applied in the Dnepr-Donbass canal (in the design stage) where in the zone of changing water levels reinforced concrete slabs cast in situ will be placed to protect the slopes from the action of waves and ice.

If the ground at the bottom of canals is subject to strong deformations from heaving or sagging, it is advisable to use concrete film linings covered with built-up concrete or concrete cast in situ. These linings have been widely used in rebuilding the main North Crimea Canal, and in building the Azov, Krasnogvardeyskiy and other canals in Crimea. The total area of concrete film lining consisting of built-up reinforced concrete slabs and concrete cast in situ applied in the Ukraine alone (between 1969 and 1971) exceeds 2.2 million m².

For the lining of film screens in canals, coarse gravel and sand concrete have been used. Lining thickness is not less than 8 cm.

When building canals on rocky, gravelly or pebbly ground, a preliminary layer of sand or sandy loam (not less than 10 cm thick) is laid on the canal bottom and slopes.

Special placers have been designed to mechanize the installation of concrete film revetment in canals up to 1.2 m in depth.

When placing precast slabs for concrete film revetment, the following two types of joints are used: continuous rigid joints of concrete cast in situ, and deformation joints filled with sealing materials such as pore-sealing material and thiokol cement.

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We studied the design of joints using a stabilized polyethylene film 0.2 mm thick introduced into the concrete of adjoining slabs. The joint was filled from the top with fine-grained concrete.

Investigations have shown that the problem of sealing joints in canal revetments and in hydraulic structures can be solved conveniently by using polymer mastic.

Observation of the operational efficiency of various sealing materials, and analysis of laboratory data on their adhesive (to the concrete) and cohesive strength, resilience, water and cold resistance have made it possible to set up specifications and testing techniques for polymer sealing materials used in irrigation construction.

From the study of the durability of film materials of varying thickness placed underground in various soil-climatic zones it has been possible to predict that the service life of 0.2 mm thick stabilized films will be not less than 35-40 years in the central regions of the U.S.S.R., and not less than 25-30 years in the southern ones.

On the basis of the work performed we have worked out recommendations for the use of anti-filtration screens made of polymer films in irrigation canals and reservoirs entitled, "Provisional technical instructions for designing, building and operating polyethylene anti-filtering devices on dams made of local materials." We have also prepared recommendations for designing and installing concrete film revetments in irrigation canals, and specifications for designing, building and operating polyethylene anti-filtering devices in earthwork of water reservoirs.

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2. The use of films in the construction of water
reservoirs for the control of local runoff

Polymer films made of PE and PVC have been studied and used since 1959 as anti-filtration screens for the beds of various types of water reservoirs and storage basins. Reservoirs with such types of screens have been built in the Armenian, Kazakh and Tadzhik republics.

The largest reservoir built with a film anti-filtration screen is the Tortgul'skoye reservoir in the Kirgiz S.S.R. (the area of the installed polymer film covers 657 ha). An 0.2 mm thick stabilized polyethylene film was used to build the screen.

The construction schedule for the reservoir was shortened by one year, and its cost was cut by 2.5 million rubles.

Local runoff in areas with complex hydrogeological conditions can be properly used and controlled by building artificial reservoirs and ponds with anti-filtering revetments. The technical and economic analysis of various alternatives has revealed that the most efficient way of handling this problem is to use a polymer film with a protective layer of soil. The cost of 1 m² of anti-filtration screen with a polymer film and a protective layer of soil varies between 0.8 and 2.1 rubles, depending on the geological conditions of the reservoir bed.

3. The use of films in the construction of
reservoirs for drainage waters

As water economy and industrial construction expands in the U.S.S.R., experience is being accumulated as to how to protect water sources against pollution from drainage waters and sewage by using polymer films as anti-filtration screens.

The results show that polyethylene films are very stable in discharge waters from soda and superphosphate production plants and in other similar media.

Settling basins for aggressive media, of various sizes (10-25 ha) and capacities, have been built and are operating now; these are, for instance, non-filtering slime ponds with polyethylene screens at the Lisichanskiy soda factory or at the Dzhambul'skiy double-superphosphate factory.

Tests on samples from films and joints of polyethylene screens from slime ponds have shown that after four years of operation the strength and deformation characteristics of the films have not dropped below allowable limits.

The construction of settling basins requires high-quality work in welding or pasting the film into panels, joining the film screens with the structures, preparing the base, and pouring and leveling the protective layer (with due consideration of the granulometric composition of the soil employed).

To place a protective layer over a film at hydraulic structures having large-size horizontal surfaces (large-size reservoirs, etc.), a technique has been devised which uses as a protective layer water, pulp or mud poured into pools on already formed panels. This method makes it possible to protect the film from the effects of weather, to cut down on labor-consuming operations and reduce construction costs, check the quality of the film joints of the panels, and create more favorable operating conditions for the film lining.

We also designed devices for periodically checking the quality of films during construction using non-destructive testing methods.

4. The use of polymers for artificially stabilizing the soil on the slopes of canals and reservoir dams, for improving the quality of concrete, etc.

Soil stabilization methods using synthetic resins have been greatly expanded in recent years.

There are two ways of placing soil-fixing chemicals on the slopes of canals and dams: jointly with the optimum medium for plant growth (hydro-seeding) or by injection (after seeding).

Test results indicate that it is expedient to use a slowly dissolving bituminous emulsion. There forms on the surface a stabilized 2-5 mm thick soil crust which protects the slope from erosion by surface water, or from sliding, and which improves the moisture and heat regime of the soil. These emulsions have an adequate adhesive capacity with the soil surface and thus provide firm stabilization.

In areas of irrigation farming and intensive cultivation it is advisable to use latexes since they are nontoxic, do not pollute the biosphere, are technologically effective and easily transportable. Field experiments were conducted to study the efficiency of latexes in protecting sandy and sandy loam soils from erosion. An increased resistance to erosion was observed also in heavy-loam chernozems treated with latex. Some 20 to 30 minutes after the latex has been applied, an elastic film forms on the surface of soil aggregates and in the spots where they are in contact. This film fixes the soil particles and improves their resistance to retirement and erosion, and also their water stability. The latex film is hydrophobe so that water evaporation from soils processed with it can occur only by diffusion. The biological processes

occurring in latex-treated soils have also been studied. It has been found that the application of latex produces no negative effects on the biological processes occurring in the soil.

Investigations have begun regarding the application of polymerized concrete in the construction of reclamation systems, and the selection of the compounds for the impregnation of concrete; pilot plants for the manufacture of polymerized concrete are being designed.

It is advisable that in the future the exchange of information be expanded along the following lines:

1. Development and investigation of butyl-rubber films, ethylene-propylene copolymer films, reinforced films and other polymer film materials with increased bursting and tensile strength. Development and investigation of adhesive tapes with one- or two-sided protective coating for splicing and repairing polymer screens.

2. Improvement of the techniques of film screen construction in canals and reservoirs (preparation and installation of film panels, joining panels to one another, checking the quality of installed screens), development of machinery for the preparation of foundations for film screens, the even distribution and stabilization of the protective soil layer.

3. Study of the durability of new film materials and development of structural design techniques for film screens used in the construction of hydraulic systems, or of structures on slumping ground. Study of the operational stability of film screens in settling basins upon contact with aggressive drainage waters and sewage. Development of methods for checking the tightness of film screens during the filling of the protective soil layer and during operation.

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4. Development of techniques and equipment for the application of soil-fixing chemicals on canal slopes and direct grassing of slopes in conjunction with stabilization with soil-fixing agents to clean irrigation canals.